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## ORIGINAL ARTICLES.

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### THE CILIARY PROCESSES IN ACCOMMODATION.\*

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THE object of this paper is three fold:

1st—To urge the importance of the ciliary region as the physiologic center of the eye.

2nd—To point out that the most commonly accepted theory of accommodation lacks one essential element to make it operative.

3rd—To show that the acceptance of this view makes the ciliary region the pathologic center also.

In practically every case that comes under the observation of the ophthalmologist except such as are obviously traumatic or due to some constitutional lesion, and even occasionally in these, that part of the eye of primary importance in its bearing on the conditions present is the mechanism upon which accommodation depends.

Being the intermediary apparatus between the cornea and the retina and having attachments to the choroid, there is actually no intra-ocular disease which may not be modified by the condition of this pivotal structure on which the act of vision turns. It is possible that a better understanding of

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the relationships of the tissues entering into the mechanism of accommodation in the human eye, may throw the needed light on the causes of the obstruction of the filtration angle in that obscure problem chronic glaucoma, notwithstanding the experiments of Hess and Heine tending to show that accommodation does not increase the intra-ocular pressure. A fuller knowledge as to the properties and functions of the congeries of bloodvessels constituting the ciliary processes will make clearer the nature of the retrogressive nutritive changes which result, often prematurely, in cataract. The irritation produced by strained focal efforts is often the dominant cause of retrogressive corneal changes, and the relief which follows the use of atropine is due to the quieted ciliary body rather than to any effect of the drug on the cornea itself. It follows, therefore, that as almost all abnormal eye conditions are attached to, if not contingent upon refractive aberrations, it is of first importance that the anatomic and physiologic relations of this region should be clearly understood. It seems curious that with all the careful studies that have been carried on during recent years concerning the finer workings of human structures, one function that as yet has, at least measurably, eluded us, is performed in perfectly plain view, and is under our combined critical observation thousands of times every day. Whenever we look into the human eye accommodative changes are taking place, but so quickly and smoothly do the movements occur that they are absolutely invisible to us. It is only when they are interrupted—when some obstruction gets into the evenly working cogs and the natural processes are retarded—that we can in some measure see what had been taking place. It is, to change the figure, as though a stream were flowing so swiftly as to appear to stand absolutely still and it is not until the flow is impeded that we are able to realize the nature of the current and the rapidity and direction of its motion. Hence it is that, important as are the studies of the physicist and physiologist concerning this function of the human eye, it is to the clinician and the pathologist that we must come for the final word on the subject.

The test of a theory is that it perfectly explains the action of the organ to which it applies; and it must fall in line with

each clinical condition as it arises. None of the theories which have so far been formulated in regard to accommodation meet those requirements, and I wish to suggest one which seems to do so.

Briefly, there are three possible methods by which accommodation could be effected, excluding, as disproven, any alteration in the curvature of the cornea, or of the fundus, or any backward and forward movement of the entire lens. These are: First, the method of Helmholtz based upon an inherent elasticity within the lens capsule with a relaxed zonule and requiring for a shortened focus an increase in curvature of the entire anterior lenticular surface. Second, the method of Tscherning founded on the assumption of the formation of a lenticonus in accommodation, with a tense zonule; and, Third, the method of Dudgeon which seems to have been overlooked by most observers, as I can find no reference to it, and which assumes an inelastic lens and requires as an explanation of its focal adjustment an axial rotation which as the lens is paraboloid in form and not bi-convex, would give in effect precisely the lenticonus that Tscherning thinks that he has demonstrated.

Assuming then that Tscherning's observations which have been so carefully made and so accurately described are correct, and omitting any discussion at this time as to the possibility of an axial rotation as suggested by Dudgeon, the inquiry naturally arises whether the mechanical changes which occur in accommodation are inadequately explained by the employment of the ciliary muscle alone. It does not seem to me that they are. It would be impossible with a relaxed zonule, such as Helmholtz thought obtained in accommodation, to have the lenticonus as a result which Tscherning has practically demonstrated. Tscherning's theory on the other hand does not seem adequate to explain the phenomena which undoubtedly occur. Long before Bowman's discovery of the long fibres of the ciliary muscle, or of Müller's of the circular ones, it was believed that the large vascular plexuses constituting the ciliary processes and which from their very bulk occupied so much of the limited space in this region exercised an influence on accommodation. But when the microscope showed the true structure of the ciliary muscle.

the assumption quickly followed that it was to its action alone that all focal changes should be ascribed and that the ciliary vessels had purely secretory and nutritive functions. When, however, we note the size of these vascular masses, especially large in some of the lower animals, and consider how their bulk would be increased when engorged with blood, it can scarcely be doubted that the resultant pressure would affect the delicate adjustment upon which they actually lie.

The long fibres of the ciliary muscle are attached anteriorly in the sclero-corneal tissue constituting the boundary wall of Schlemm's canal. They are attached posteriorly to the choroid. The fibres of Müller form the angular ring beneath those of Bowman.

The physiologic action which follows would almost seem obvious. A contraction of the long fibres relaxes the zonule. Coincidentally with this, the circular fibres surrounding the margin of the iris contract, impeding the free venous flow and causing the ciliary processes to become turgid with blood, they in turn pressing, by their bulk, on the anterior part of the suspensory ligament of necessity flatten the edges and protrude the center of the lens in exactly the form that catoptric tests have shown to be present.

Accommodation having been completed, the muscles relax allowing the vessels which had been full, to empty, in all probability in doing so allowing the overflow to pass into Schlemm's canal.

It will be evident from this that as the artery leads by way of a very large capillary into the anastomosing mass of veins that the passage of blood into the capillary processes is practically unimpeded. That an increase in bulk in the ciliary region occurs in accommodation, has been noted by Tscherning who does not ascribe it, however, to the cause which I have given. He says, "There is formed during accommodation at the anterior surface of the iris a circular depression—the peripheral border of which corresponding to the ciliary body rises in a peak while the central border presents a very gentle slope corresponding to the anterior surface of the crystalline lens."

In order to understand the mechanism of binocular vision, it is necessary to predicate not only a cortical macula but for

each terminal retinal element a corresponding neuron in the visual center. We have, then, two overlapping impressions requiring exact adjustment in order that the foci may be clearly defined in every meridian of each area. That this nicety of adjustment may be maintained it is not alone necessary that the angle of fusion, as Nagel calls it, shall be correctly balanced, but that every retinal meridian shall be so focused that, if possible, a visual image free from distortion shall result. With both corneæ nonastigmatic to obtain such a perfect visual impression requires the co-operative efforts of all the extrinsic muscles and both the ciliary bodies. Paralysis of the nerve supplying any one of these muscles will make such a result impossible. Perfect vision, however, as nearly as it can be measured, is also obtained when the corneæ are moderately astigmatic and in occasional instances when marked differences in the radii of the corneal meridians are present. It does not seem possible that this could be produced by rapidly alternating the meridians through which the approximately perfect vision can be obtained, which is the usual explanation of this phenomenon. Moreover, it is a well authenticated fact that the astigmatic angle changes under a cycloplegic.

Tscherning accepts the idea that it is possible by exerting traction on the suspensory ligament on opposite sides through the same meridian to make a lens astigmatic, and quotes in a foot-note in his *Physiologic Optics* the interesting experiment of Stadfeldt upon a lens freshly removed from the human eye. "In consequence of traction" in opposite direction "he always caused astigmatism, the maximum of curvature corresponding to the direction of the traction. On a crystalline lens belonging to a person aged 38 years he thus produced an astigmatism of the anterior surface of 4 diopters. The posterior surface was very slightly influenced. The astigmatism disappeared with the traction."

These facts justify the belief that accommodation is not always produced by the action of the entire ciliary body, but that opposing segments in the same meridian may in whole or in part correct the opposing corneal deformity. The number of ciliary processes is not uniform in all eyes. There are usually about seventy-two, which would divide the



corneal periphery into arcs of five degrees each, as small a division of the circle as is necessary for an astigmatic correction.

In normal accommodation, then, there must be a conjugate action of the part of each ciliary neuron with the corresponding neuron in the fellow eye. In astigmatism nervous energy would be carried to corresponding groups in the two arcs of the same meridian in each eye and in unsymmetric astigmatism to disassociated groups in unsymmetric meridians.

This explanation of the ciliary activities makes it quite possible to understand the development of sympathetic ophthalmia with an absence of infectious germs.\* A traumatism involving a ciliary segment in one eye causes a persistent irritation at the point of injury. Since there is a conjugate action on the part of each process with the corresponding process in the fellow eye, the excess of energy transmitted to the one eye is also sent to the other and the sympathetic irritation becomes an inflammation or a cyclitis. As the nutritive conditions of the lens are dependent upon the smoothness with which the ciliary processes fill and empty themselves, refractive errors, especially when astigmatic, interrupt its normal lymph supply and, if not the direct cause of cataract, are not rarely an important element in its development.

Now, if the idea to which I have given expression be the true one, that the ciliary *processes* constitute true erectile tissue and enter as an essential element into the accommodative act, a series of pathologic events may be explained in logic sequence, for is it not the irritation of muscular effort that would result from any form of eyestrain but a venous stasis involving the veritable physiologic center of the eye.

After years of controversy, Schwalbe's contention that Schlemm's canal is a venous reservoir serving to receive the overflow from the active ciliary processes has now been very generally accepted as practically proven.†

It would follow, then, that any undue or irregular accommodative effort would produce a passive ciliary congestion

\*Ayres and Alt, American Journal of Ophthalmology, Feb. 1898.

†See "System of Diseases of the Eye," Norris and Oliver, p. 250.

rather than an irritation. This would involve the venæ vorticosæ.

Since convergence and accommodation are coincident they must for their normal accomplishment require a perfect balance of all of the muscles entering into the visual act. Excessive strength either anatomic or dynamic on the part of the externi causes undue effort on the part of the interni with ciliary spasm, which is congestion of the ciliary processes. We will look then in malignant myopia not to the refraction alone but to the muscular imbalance before the progress of the disease shall be halted. As the nutritive channels arise from the same source the same cause might under other conditions in the young, cause like degenerate changes in the anterior part of the eye producing conical cornea and in the adult, glaucoma. It is not the purpose of this paper to discuss these possible resultant changes, but to urge the importance of the vascular element in accommodation and to point out the long and important line of ocular lesions which may find adequate explanation in this theory.

Indeed, accepting the theory of the segmental and conjugate action of the ciliary muscles together with the associated action of the ciliary processes as an essential element in accommodation, we have an intelligent explanation of the causes of inflammatory and degenerative changes within the eye dependent upon astigmatic conditions and muscular imbalances and through the same causes by disassociations of correlated brain centers of irritative, nutritional and psychic disturbances involving other and remote organs.

#### DISCUSSION.

DR. LUCIEN HOWE (Buffalo): It strikes me that our early masters in ophthalmology and students of this subject are after all not so far apart from each other in their conclusions. The evidence tends to show that the contraction of the ciliary muscle is to relax the zonula. In spite of that, however, we must regard the accommodation as essentially an active effort.

Hess says if you take the eye of a child and dissect it out and draw on the ciliary processes, you can get reflections from the anterior and posterior surfaces and notice what

effect traction has on the shape of the lens. The eye of an ox or a hog can be used for that.

Another point in regard to the position of the lens: We usually think of this as being placed exactly perpendicular to the axis of vision; that however is not the case—it is ordinarily tipped temporalward, or also a little forward. If you doubt that, take the ordinary ophthalmometer and remove the prisms, thus converting the instrument into a telescope, and the reflections from the lens show clearly its abnormal position.

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### SOME OF THE ACCIDENTS AND COMPLICATIONS MET WITH IN THE EXTRACTION OF CATARACT.\*

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THE writer has enjoyed unusual opportunities during the past twenty years for observing the process of opacification of the lens in a large number of men past middle life, and also to have made upward of one thousand extractions of the lens in private and in hospital practice and, in the "eye wards" of the the hospital at the National Military Home, near his home city, after different methods and under different conditions. This experience has given him the opportunity to judge of the relative merits of the different operations usually employed and to select those best suited to the class of cases he meets with.

The purpose of this paper is to treat of accidents and complications, as he has seen and treated them.

A well conceived and properly executed extraction is probably the acme of surgical skill. No other operation approaches it in definiteness of conception, delicacy of execution, in the nicety with which the different steps are carried out, the object to be attained, and lastly the contentment and joy it has brought to humanity. Other operations relieve suffering, some prolong life; and some correct deformity, but the extraction of the opaque lens does all of these

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and more. Unfortunately this ideal is not always realized by operation. Accidents and complications confront us on every side, and sometimes defeat our best endeavors for the restoration of vision.

Going briefly into a historical review of the operation, in 1706, Petit, as I understand it, was the first to extract the lens (not a cataract) for restoration of vision—a dislocated opaque lens, from the anterior chamber, through an incision not definitely located, but probably corneal, made with a large needle for the puncture, and scissors to complete the section. The credit of priority in extracting the lens is usually given to Daviel, in fact a monument stands in a little cemetery about two miles northeast from Geneva, Switzerland, commemorative of this claim. Daviel himself has given the credit of priority to Petit, but there can be no question, I think, that the credit of operating for cataract, by extraction, for restoration of vision, within historic times, belongs to Daviel, 1745. Beer and others followed him and added iridectomy and, best of all, Beer devised the triangular knife which bears his name, and has been the most important factor in the evolution of the flap operation, since it enabled the operator to make the section with one instrument, which had not been possible up to his time. While the operation and the knife are seldom used now, the lessons to be learned from its use and the principles involved in its execution have been of great value. (Waldau's scoop-extraction with small corneal section, in 1860, was another step in the evolution of the operation).

Mooren's flap section and preliminary iridectomy in 1862, and Jacobson's method, followed about the same time.

This brings us down to 1865, a period of 120 years in which all extractions were made after the method of Daviel, with all the accidents and complications inherent in the method, due largely to the great size and peripheral location of the incision and the bruising of the iris in delivering the lens, and a lack of knowledge of aseptic precaution for the prevention of wound infection, and lastly, the local anæsthetic power of cocaine was not known.

Von Graefe's linear extraction with the long, narrow knife which bears his name, came into general use after 1865.

It was soon found desirable, on account of accidents and complications which occurred, to shift the line of the incision from the edge of the sclera forward into the cornea and combine an iridectomy with it, as Desmarres had done since 1856.

This brief review is not intended to go more deeply into the subject than seems necessary to illustrate the title of the paper, and show that many of the accidents and many of the complications were inherent in the methods themselves and in the want of knowledge of pathological processes as illustrated in wound infection—the *bête noir* of all operations. It could easily be shown that accidents are not so common and complications not so serious as in former times, but these facts are self-evident and need not be repeated here. The simple operation as made to-day is essentially that of Daviel, except that the incision is made upward and with one knife. The combined operation is made in all respects just as it came from the hand of Von Graefe, with the single exception that the incision is shifted and is now made within the cornea. Truly there is little that is new in cataract extraction. The eye is a small organ, and, it would seem, has been exploited surgically to about the limit, that is to say the number and kind of operations it will admit of has been about reached; henceforth it would seem that the application of the principles that underlie these operations and their adaptation to different conditions, attention to the preparation of the patient, attention to the carrying out of details, and the care of accidents and complications as they arise, will be the portion of future operators.

No arbitrary definition of accidents and complications can be given, nor a rigid distinction made between them, but for our purpose it will be sufficient to regard accidents as preventable happenings. In other words, they are some departures from the usual steps of an operation which should not have occurred, for which the operator, as a rule, is responsible. Accidents are operative, and occur during the different steps of the operation. Introducing the knife upside down, while not an accident of frequent occurrence, happens to all men who do much operating. It is inexcusable and ought never to occur, to an operator of good vision,

and need not if we would be careful to look for the name of the maker which is usually stamped on the back of the knife handle, and is a good guide to the location of the cutting edge. Fortunately it is not a serious accident. By withdrawing the knife and waiting for fifteen to twenty minutes, the chamber will have filled again and we can proceed as if nothing had happened. Turning the knife without withdrawing has been tried, but the aqueous escapes, the chamber is abolished, the iris falls over the blade of the knife, and a counter-puncture cannot be made without doing damage to the iris; therefore this plan has been partially abandoned. The aqueous is allowed to collect and then proceed as if nothing had happened out of the ordinary.\* Failure to enter the anterior chamber with the point of the knife and pushing it through the lamellæ of the cornea can easily happen to the inexperienced operator, and a section made too angling through the cornea, will leave a broad linear opacity.

Probably the most frequent accident met with is that of making the section too small for easy and gentle delivery of the lens. In the writer's experience, it has happened from one of three causes: first, failure to appreciate the relative size of the lens to the diameter of the cornea; second, from rotation of the globe on its axis, from pressure in making the puncture and passing the knife through the anterior chamber for the counter-puncture. (If the knife is sharp this is not likely to occur). Third, from making the section so slowly that the aqueous escapes, the iris falls over the blade of the knife and the position of the point when counter-puncture is made cannot be seen. If the section proves too small it should be enlarged with scissors sufficiently to admit of easy delivery of the lens, for it is far better to have too large an incision than to force the lens through an insufficient opening and bruise the angles of the incision, entangle the iris, and strip off cortical matter. The angles are favorite starting points for infective processes, and cortical debris cannot always be seen until it becomes opaque. It is not

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\*Since this paper was read the writer has had this accident happen to him again. It was remedied by making the counter-puncture quickly, rotating the knife and completing the section quickly. And he has lately seen the same accident happen to Dr. Knapp in New York, who treated it in the same way.

always absorbed, but may become organized and then must be dealt with surgically at a later date. Hæmorrhage into the anterior chamber may come from the incision being too far back in the corneo-scleral junction. It may occur on completion of the section or after the iridectomy has been made. Previous inflammation from any cause, operating to increase congestion in the anterior segment of the globe, predisposes to it. It is seldom serious enough to interfere with the subsequent steps of the operation, and if removed quickly by pressure with spatula before it coagulates, time is given to deliver the lens, the pressure of which usually stops the hæmorrhage. If it still persists, a sterile solution of adrenalin may be injected. The presence of the hæmorrhagic diathesis complicates the situation.

The iris falling over the knife while making section usually occurs from one of two causes, or both operating together. High normal tension, or making the section too slowly. The writer has not had much trouble from this accident since he adopted the plan of turning the blade of the knife forward, when it occurs, at an angle of from 60 to 70 degrees, and pressing backward with the back of the blade while the section is completed in the usual sawing manner. The same manœuvre serves a good purpose in preventing this accident in cases of mature cataract where the process of opacification is just completed and the swelling of the lens obliterates the anterior chamber and it is not desirable to wait for shrinking.

Statistics show that prolapse of iris occurs in from three to ten per cent. of cases among the best operators and with the average class of patients. In our last 100 simple operations, we had this accident occur in ten cases. This is too high a per cent., and we have sought an explanation of it, in the character of the patients we have to deal with. As a rule they are not good subjects for operation. Many are broken in health and feeble in mind from dissipation and other vices.

The danger seems, to a certain extent, inherent in the operation itself, and also to the unknown condition that causes one patient to have higher (normal) tension and greater tendency to prolapse than another, and not to the operator; if it were otherwise, we could name a long list of

experienced men who ought not to meet with these accidents, but they tell us they do meet with them—therefore it seems reasonable to conclude that the cause of their occurrence is fundamental, inherent in the method itself, or rather in the principles that underlie its performance and the causes given above. This view is emphasized by the fact that the accident in the modified form of entanglement is seldom met with after a well executed combined operation when careful attention has been given to details and to the so-called toilet after the operation.

The writer prefers the combined operation for the class of patients on whom most of his operations have been performed, and makes it in the great majority of cases. The objections urged against it that it mutilates the iris and furnishes a focus for infection there, is more than offset in his judgment by the difficulties encountered (in delivering the lens and the accidents entailed) in the simple operation. But he is always ready to make the simple operation when the case seems suitable for it. This point is usually decided by the behavior of the iris, when the section is completed. If it prolapses, it is returned and smoothed out with a spatula; if it is retained, eserine is used and the bandage applied. In two or three hours the eye is again inspected. If the iris is in place the bandage is re-applied. If, however, it is found prolapsed, the speculum is introduced and entrusted to the hands of the assistant who lifts the lids away from the eyeball in the manner detailed elsewhere. If vitreous has been lost or is presenting, the speculum is dispensed with entirely and the assistant holds the lids apart while an iridectomy is made, the bandage is applied again, and the eye is not opened for twenty-four hours. Then if the anterior chamber is established, atropia is used; if the pupil dilates, it is repeated again in twenty-four hours. If it does not dilate, it is not repeated. It can do no further good, and in strong solution (4 per cent.) its action will last for twenty-four hours more, when there is usually no further need. The writer always uses this strength of solution in post-operative cases; by turning the head to one side and making pressure over the canaliculi he has never seen constitutional symptoms more formidable than dryness of the throat.



Loss of vitreous has happened to the writer, unfortunately, eleven times in his last 100 cases, nine times after the combined and twice after the simple operation. In no case was the loss sufficient to put the case in immediate jeopardy, and the lowest vision obtained was one-tenth with correction. In three of the eleven cases the simple operation had been attempted, but because of low tension and difficulty in delivering the lens, iridectomy was made, and delivery in the usual way with vitreous loss after the lens had been delivered.

In three cases loss occurred from straining during the operation. Three more lost vitreous in delivering the lens by hook; and in two more it was lost in delivering the lens in the capsule.

The writer has sought an explanation of the frequent occurrence of prolapse of iris and loss of vitreous, on this hypothesis: that given the type of skull in which the orbital cavities angle so far outward to the plane of the face, the recti muscles, acting within the muscular cone, exert an undue compression or traction on the eyeballs and cause the incision to gap. In such a contingency he believes these accidents very liable to happen. Some such explanation it is generally believed is capable of explaining the spontaneous cure of strabismus, and some such explanation seems necessary to explain the occurrence of prolapse and vitreous loss when no other cause for their occurrence is manifest, after excluding rough handling during the operation and high (normal) tension. In this connection reference is made to patients with very prominent eyeballs and orbital cavities noted above, where the speculum may make undue pressure and cause iris prolapse or vitreous loss, and also to those patients with small, deeply set eyes, with heavy, overhanging brows, where loss of vitreous may occur from the manipulation necessary to deliver the lens, especially if it is fluid, or rather not of normal consistency.

The lens is easily dislocated during the performance of capsulotomy if the cystotome is not sharp and undue pressure is required to open the capsule, or if an attempt is made to extract the anterior leaf. The accident usually happens in hypermature cataract where the capsule is found tough and thickened, from changes which begin after the maturity of the cataract. The causes that operate to produce this con-

dition seems to have a different effect on the zonula. It is found fragile and easily ruptured; in such a condition the lens can be easily extracted in the capsule, and this method of dealing with it is generally followed.

We all meet with difficulties in delivering the lens. In the writer's experience it occurs more frequently from the section being too small, from minus tension, from failure to open the capsule, and from failure to make the requisite pressure on the posterior lip of the section while pressure is made from below the cornea in order to cause the lens to engage in the wound. In the simple operation where the pupil seems rigid, the delivery is aided by stripping back the edge of the pupil over the presenting lens, which then engages it. If this manipulation does not succeed and vitreous presents or escapes, a scoop or hook should be passed into the eye and the lens delivered. The writer prefers a sharp hook; it is smaller, more easily introduced and when the point is engaged in the hard nucleus it cannot slip away as is so likely to happen when a scoop is used.

When plus tension is present or the normal tension for the individual is high, the section should be made slowly so that the aqueous does not gush out, the iris prolapses, and the lens escapes too quickly. I have never had a hæmorrhage into the vitreous or a serious hæmorrhage of any kind and am disposed to attribute this good fortune to the attention given to preventing too rapid delivery of the lens by holding it back with a scoop or wire loop. This simple manœuvre has seemed to be of good service in the cases where it has been tried. The writer understands that this suggestion is not new, but is of sufficient importance to be emphasized.

Some years ago this accident happened in operating on a stout, well developed soldier, who had a round, red face and prominent eyeballs with apparently too diverging axes of the orbital cavities such as I have described under the causes for loss of vitreous earlier in the paper. He began squeezing on completion of the iridectomy, the speculum was securely locked and did not yield. His face became intensely livid and his eyeball advanced until the upper blade of the speculum sprang the wound; the lens was forced out in the capsule and the vitreous body followed. Of course the eye was lost.

Two years later, the other eye was operated under general anæsthesia and made a good recovery with vision equal to  $\frac{20}{30}$  with correction. In this class of cases and in all others where the patient from nervousness, fright or disease, has not good control of himself, a general anæsthetic should be given.

In all cases of hypermature cataract and in all other cases where loss of vitreous is threatened or has already occurred, the assistant is trained to take hold of the speculum at its end and elevate it and the eyelids from the globe. This is a favorite method with the writer and has served him well in several emergencies.

Two years ago while operating before some invited guests of our state Medical Society, the writer met with an unusual accident. The abscision of the iris, as he thought, was completed. This proved not to be so, a small tag remaining unseparated. In the withdrawal of the forceps one-half of the remaining iris was torn away from its ciliary attachment. It was drawn out and abscised and the patient made a good recovery—vision equal to  $\frac{3}{10}$  with +12.

Some years ago in making a double operation on an old gentleman with hypermature cataracts, by the combined method, the nuclei could not be delivered and were given up as lost. In the first eye a thin and attenuated nucleus came from under the upper lid with the speculum where it had been carried by the gush of milky cortex. In the second eye the nucleus was taken from under the upper lid where it gave rise to the feeling of a foreign body after the bandage had been applied.

One of my patients was a gentleman from the center of our state whose right eye had been operated upon and lost from suppuration. At that time making a preliminary iridectomy was thought to be the proper procedure when the cataract was immature. The incision was made with a large triangular keratome, and a medium sized segment of iris abscised. After five days he returned home, a distance of seventy miles, by train. In a few days a letter came stating that he had had severe pain the night before, which was better at the time of writing, but that there was considerable tearing of the eye and a feeling as of a foreign body under the eyelid. He was directed to come down immediately.

He drove six miles in a buggy, returning here by train, and then walked two blocks to my office. When the lid was raised it revealed the corneal incision opened by the pressure of the swollen lens which was well engaged in it. At the hospital all that was needed for the delivery of the lens was clipping each angle with the scissors. The patient made an uneventful recovery; the vision was equal to  $20/40$  with correction. There was no history of injury to the eye while at home, but what probably occurred was a small injury to the capsule from the point of the keratome or from the forceps in catching the iris. The swelling of the lens followed, the tension became plus, the wound sprang open and practically spontaneous delivery of the lens occurred.

Complications are usually post-operative, but not always so. A distinction can be made between those that complicate the operation and those that complicate and delay the healing and recovery afterward. It is not always possible to differentiate between an accident and a complication. For our purpose, however, it is desirable to make a distinction between them, and we have tried to do so not by hard and fast lines but rather by grouping together in their order of occurrence and importance the different conditions that enter into and determine the outcome of the case. Of the conditions that complicate the operation we may group under corneal opacities every form of disease that affects its transparency, reserving for some later remarks, infective processes that follow operations. Under diseases of the iris synechiæ, occlusion and seclusion of the pupil, and later on we will speak of infective processes which sometimes follow. Under diseases of the lens hypermaturity, dislocation and thickening of the leaves of the capsule and friability of the zonula; under diseases of the vitreous, fluidity, opacity and infection. Under diseases of the retina and choroid we may include high degrees of myopia and retinal detachment and the various forms of inflammation met with in Bright's disease, diabetes and leukæmia.

If delirium and hallucinations are present, we remove the bandage, and if atropia is being used, stop it and give sedatives. Fright requires comforting assurance; paralysis agitans will sometimes require an anæsthetic. If an attack of

epilepsy occurs during the operation, an anæsthetic will be required to complete it.

Of the conditions that delay and complicate the healing, the most frequent is iritis; in varying degrees of intensity it is present in at least one-half of all cases, at some stage of the healing. It is generally of a mild type and yields to atropia, dionin, hot water and leeching. Occasionally it is of a severe type and an exudate is thrown out which closes the pupil or coloboma. If the patient is syphilitic, it will probably be absorbed under appropriate treatment. If rheumatism or gout are present, large doses of sodium salicylate and colchicum will usually relieve the pain and cause its absorption. If we fail with this, it will become organized and must be dealt with surgically to secure an opening through it. Opacity of the capsule from irido-capsulitis occasionally occurs and requires the same surgical treatment. Pain coming on during night, ten or twelve hours after the operation, at a time when all smarting due to it should have ceased, is a very suspicious symptom, and usually means infection of the wound, due in the vast majority of cases to undetected or overlooked lacrimal disease. Infection means auto-infection nine times in ten. Sympathetic inflammation is a complication that we have not met. Delayed union has been seen several times. We have had one case go fourteen days and heal without other treatment than the bandage. The writer believes that much anxiety and useless meddling would be avoided by letting this complication alone as a rule of practice, to which there may occasionally be exceptions.

Astigmatism is a common complication, varying from 3 to 20 diopters immediately after the operation, to about 1 diopter in a few months afterward. If the incision has been made with a sharp, keen knife, primary union occurs and the degree is low; if, however, the knife is not sharp, the incision will be ragged and the inflammation may occur and healing with higher degree of astigmatism may result, or high tension may come on and spring the wound and cause the iris to prolapse or a tag of capsule to insinuate itself in the wound and a high degree of astigmatism will result. Nature offers all the relief we can hope for in this condition, after the prolapsed iris has been abscised and proper glasses have been given.



Septic infection, next to hæmorrhage into the vitreous, is the most serious complication that can arise. It usually starts in the corneal incision, which becomes infiltrated. The edges may slough and, if the infection is intense, it may spread to the whole of the cornea. Or it may start as an infection of the iris (suppurative iritis), or as an inflammation of the vitreous body (suppurative hyalitis)—suppurative retinitis or choroiditis may also occur; but these are never primary diseases after an operation, as I understand it.

The writer has met with one case of fistulous healing. It followed a simple extraction in which the prolapse was also abscised within twenty-four hours; yet it resisted all attempts at healing, and persists to this time.

A great deal is being written now about the power of cocaine to cause in old persons softness and collapse of the cornea, and thus to complicate the operation of extraction. As pertinent to the question, and also bearing on the matter of priority in observing this property of cocaine, I beg to submit the following record from the eye-ward of the National Military Home, December 10, 1884, which the writer dictated. "Wm. H. Hood, K. 5th, U. S. C. T: Cataract extracted under cocaine hydrochlorate anæsthesia; two or three drops of the 2 per cent. solution were used at intervals until eight drops were used in twelve minutes, at the end of which time the operation was performed without pain. After the aqueous humor escaped the cornea collapsed, becoming funnel shaped and causing the extraction of the cataract to be very difficult, and after the operation was completed, the anterior chamber did not fill as it usually does, and had not filled when the bandage was applied; but next day the aqueous had filled the chamber and the case looked very hopeful. It is a question whether hydrochlorate of cocaine did not cause this collapse."

The writer has not tried to present a statistical report covering accidents and complications, but has simply related his personal experience in treating and avoiding the more important ones, as he has met them.

Convinced that some of the most valuable, lasting and helpful acquisitions to our knowledge have come, and must still come through personal experience, he respectfully submits the paper as a small contribution to that end.

DISCUSSION ON  
THE LENS CAPSULE IN OPERATION FOR CATARACT,\*

BY DR. H. KNAPP,

AND

SOME OF THE ACCIDENTS AND COMPLICATIONS MET WITH  
IN CATARACT EXTRACTION,

BY D. W. GREENE.

DR. JOHN E. WEEKS (New York): The subject of cataract extraction and the treatment of the capsule is so extensive that detailed discussion would occupy much more time than we are permitted. I shall therefore speak of but a few points. In regard to the incision, I infer from a synopsis of the paper first read that the author's incision is corneal. I think the incision that gives the best result is the incision made in the vascular portion of the eye—the limbus, and the making of a conjunctival flap. Another point is the removal of a portion of the capsule. I fully agree with Dr. Knapp that the removal of the anterior portion is difficult and apt to cause complications. I have tried a number of instruments for this purpose, but none have been perfectly satisfactory. In regard to the capsulotomy, I think that the method of opening the capsule advocated by Dr. Knapp is extremely good, but it is not free from objections. The capsule is not infrequently torn by the lens as it escapes and you do not get a simple linear incision in all of the cases. As Dr. Knapp has said, wherever the capsule is opened there is a scar and thickened line which makes the subsequent capsulotomy relatively difficult. If we can get an opening which will lay bare the posterior portion of the capsule, as is often accomplished by the Graefe capsulotomy, subsequent operation, if necessary, is comparatively easy and simple. In many cases a secondary operation ("needling") is not necessary. Where the margins of the torn capsule come in contact with the iris there is apt to be an adhesion—posterior synechia. As a rule this amounts to nothing, but it is advisable to prevent it as much as possible.

With regard to the combined or simple operation, it has often occurred to me to put the question to myself, if I had a cataract, which operation would I select? I think that I

\*See September number of this journal.

should select the combined operation. A large experience with both methods has led me to believe that the complications that may follow the simple operation are more serious than those that may follow the combined operation.

DR. EDWARD JACKSON (Denver): For several years I have done the opening of the capsule in this way: After completing the corneal section, if I intend doing simple extraction, or after turning down the conjunctival flap from the cornea—for I aim to get some flap at the center—I dip the cataract knife into a pitcher of boiling water held by the nurse at my elbow, then introduce the back of the knife into the corneal section, drawing it back toward the point of original puncture. After an iridectomy, added space is secured by the iridectomy; but in even simple operation, with a small pupil, it is not difficult to do this. Bring the knife to the side of the pupil nearest the original corneal puncture, allow the back of the knife to press on the iris and retract it some distance; then make a puncture in the lens capsule with the point of the knife. Carry the point of the knife forward to the other side of the pupil and even cut the capsule back of the iris, without injuring the iris. Withdraw the knife, and that completes the opening of the capsule. I first undertook this method of opening the capsule fearing that the result of such a manoeuvre would be an inadequate opening, that the capsule would offer resistance to the extraction of the lens. I never have been conscious of the slightest resistance after such an incision except in two cases in which the cataract was hypermature and the capsule unusually thickened. Whether the incision splits from the ends and extends out to the edge of the lens, or whether the stretching is sufficient to permit of the nucleus passing through it I cannot say; but the fact is that after such an incision, which is not difficult to make, the lens comes out without difficulty. The results have been all that Dr. Knapp has claimed for his incision. It is of the same kind, but not quite so peripheral as his. There are sometimes adhesions at the points where the incision would cross the pupil, but they give very little trouble, and the scar, if there is a noticeable one, is out of the way of the central pupillary region. I am sure that the number of cases requiring a secondary operation has been rather smaller since

I adopted this plan. Some of the cases have been watched from time to time during ten years. I have operated upon something like 300 cases by this method. I have not encountered any serious difficulty, and the results have been a capsule that is easy to deal with if it requires subsequent attention.

DR. A. A. HUBBEL (Buffalo): My experience has now been sufficient to warrant me in saying a word on this subject. It is an important one, and none of us, in five minutes, can discuss any part of it fully. I wish to speak, first, as to the manner of making the incision. I believe that the original incision of Daviel is ideal, except that he made it downward instead of upward. It is made directly in the corneo-scleral junction, and should be large enough to give easy egress to the lens. I do not like to go back into the conjunctiva very much, because there is thus a liability of getting hæmorrhage into the anterior chamber, which adds to the difficulty of properly opening the capsule. The question has been uppermost in my mind for a number of years as to whether I should do the simple or combined operation. Of course all of us have been tempted to do the simple operation, but it has its drawbacks, and to my mind they are in excess of those of the combined operation. I agree with Dr. Weeks, that if I had a cataract and it was to be removed, I should prefer to have it done by the combined method. I wish to call attention to the method of "button-holing" the iris, practiced by the surgeons of the Massachusetts Eye Infirmary of Boston. The operation is done after the simple operation is completed, when, with a delicate forceps the iris is grasped as near the periphery as possible and a small fold is brought out and excised—the smallest possible portion. I have been doing this during the past summer, and, while my experience has not been large, it is very satisfactory. It is somewhat difficult to do, as the patient's eye must be still, and as it is not easy to limit the amount of iris to be excised. I believe the prolapse of the iris in simple extraction is due more to the pressure of the aqueous humor from behind than to any other cause. This button-hole operation leaves an opening through which the aqueous passes, and it does not collect beneath the iris to press it out before the union of the corneal wound takes place.

The treatment of the capsule is another important subject, and much might be said in regard to it. I have tried Dr. Eugene Smith's capsule forceps, but I have not been very successful in using them. The fault is doubtless mine. I have tried Dr. Knapp's and other methods, but have come back to making the T-shaped incision of Graefe, as described here to-day. After the lens is extracted, irrigate the anterior chamber according to the method recommended by Lippincott of Pittsburgh. I have used his treatment for two years and I believe that increased success will come from practicing this or some other method of irrigation. It is done easily, the lens and blood-debris is thus removed, and little is left to produce opacities, or to cause irritation and inflammation.

DR. EUGENE SMITH (Detroit): The method of button-holing the iris has been used a hundred years more or less. It is a simple thing to remove the anterior capsule; I have been doing it for twenty years in every instance. As it has been remarked, we not infrequently deliver the entire lens in its capsule, and without loss of vitreous when the capsule is thickened. In regard to Dr. Knapp's forceps, it is a little difficult to make them bite; the blades come together, and if you are not careful you will pinch up a fold of the iris. The teeth should come together and yet leave a little opening between the blades as in my forceps. I prefer a little drop to the portion of the blades containing the teeth. They drop into the pupillary space while the blades are on a plane with the iris. I have examined the capsule extracted with the microscope and have observed that it measures 3x5 mm. I have never seen a lens dislocated. There is no necessity of making such deep pressure. I have had to make dissection of the capsule in less than 3 per cent. of my operations. I have had the little adhesions that you are bound to have with whatever operation you make. You will get posterior synechiæ—you cannot help it. Regarding the prolapse of the iris, I read a paper at the last meeting of this Academy regarding the hypodermic use of morphine after operation. I have used it for fifteen to eighteen years, and I have operated on many cases. I prefer the simple extraction in suitable cases, but always in my simple cases the hypodermic injection of morphia,  $\frac{1}{8}$  of a grain every three hours until



three doses are given. I use eserine also when finishing the toilet. I am a strong advocate of the use of capsule forceps, and morphia in simple extraction. I use the capsule forceps in all cases.

DR. ALBERT R. BAKER (Cleveland): I wish to add my testimony in favor of the peripheral capsulotomy of Dr. Knapp, which was the first one I made and the last one. I have tried the capsule forceps of Dr. Smith, and I think I have tried them all, but I find that after a few trials I go back to the peripheral opening of the capsule of the lens. I do not see that I have to make any more secondary operations when I make the incision than when I make any other.

With regard to accidents, the escape of vitreous is the one I have always feared the most, and have frequently attributed it to the awkwardness of my assistant. To avoid this difficulty, I adopted several years ago a plan of operation, which is not original, and that is of discarding the speculum and grasping the superior rectus above the cornea with the fixation forceps instead of below, thus holding the upper lid out of the way with my forceps. It is surprising how easily and how accurately the incision can be made with almost no fear of escape of vitreous from pressure or pulling upon the eyeball by assistant or squeezing the lids together on the speculum by the patient.

DR. JOSEPH E. WILLETTS (Pittsburgh): It seems to me that the best operation is that operation by which the lens may be extracted in the quickest possible time, with the least interference to the eye. This is unquestionably accomplished by the simple extraction. I have been present at some fifty odd consecutive operations by Dr. Knapp, in which the lens was extracted by the simple method, the capsulotomy being peripheral; and since that time I have advocated the simple extraction and operated by that method exclusively. I prefer the incision through the corneo-scleral margin. The capsulotomy which Dr. Knapp recommends, I do not like, probably because I am not as fond of doing dissections as he is. I make a central capsulotomy, crucial in shape. It seems to me it is bad surgery to do a preliminary iridectomy, when it is not essential to results to be obtained, and it is equally bad to do peripheral capsulotomy, which almost invariably

necessitates a dissection. I am not in favor of subjecting an eye to three distinct operations, where one suffices.

DR. HERMANN KNAPP (closing discussion of his paper): (Dr. Knapp illustrates at the blackboard). When you look sharp at the exit of the lens through the pupil you see that the edge of the iris is notched, but the little angles disappear when the lens is out. These little ruptures of the iris come in contact with the shreds of the torn capsule of the lens and produce synechiæ. When I was in Vienna years ago, Prof. Arlt said he had never seen them, but when I looked at his patients with oblique light I found that there were a number of them, and he said, "Yes, they are agglutinations and have nothing to signify." When these ruptures of the iris come in contact with raw surfaces of the shreds of lens capsule we get the adhesions. If the lens comes out in its capsule, we notice no synechiæ, but we find them regularly if the anterior capsule is miscellaneously ruptured with a cystotome or other instrument. The synechiæ, I think, are ever inflammatory. Under all conditions they are better absent than present. In order to avoid them, I have for many years placed the opening of the capsule to the periphery of the capsule, about 1 mm. in front, and parallel with the corneal section. This keeps them off nearly always. Another advantage is that the anterior and posterior capsules agglutinate and are free from inflammatory thickenings, so that the capsulotome can split it easily, with better permanent acuteness of sight.

DR. GREENE (closing discussion of his paper): I have not much to say. In regard to the incision Dr. Weeks speaks of, I have tried to make it as seen in Paris—a corneal section starting well back. I have never made a conjunctival flap. I have never seen cases where I thought it would do good. The extraction of the anterior capsule is easy. I saw Fuchs do it in 1888 and have seen many since, and it is very easy I know of nothing easier. I have a record of 150 operations after I had studied at the feet of Dr. Knapp of New York, after his method. I do not like it, and abandoned it because of the necessity of needling that followed. All the cases of glaucoma I have had, excepting two, have followed needling. I dread the needling more than extraction, so far as glaucoma is concerned.

## ABSTRACTS FROM MEDICAL LITERATURE.

By W. A. SHOEMAKER, M. D.

ST. LOUIS, MO.

### THE TREATMENT OF PURULENT CONJUNCTIVITIS.

Miles Standish (*Jr. A. M. Ass.*, Dec. 17), from a study of the records of the Mass. Charitable Eye and Ear Inf., presents the following conclusions:

1. That the newer silver salts are more easily applied, safer in use and produce better results than nitrate of silver.

2. That in cases of ophthalmia neonatorum either protargol or argyrol is an entirely satisfactory agent.

3. That in cases of gonorrhœal ophthalmia in the adult, the results obtained when treatment is begun early are approximately the same with either preparation, but when once the cornea is involved, protargol appears, in these cases at least, to have offered a better ultimate outcome.

4. That the application of cold during the stage of swelling in gonorrhœal ophthalmia is a dangerous procedure and should be abandoned.

### EYESTRAIN.

Lewis S. Dixon (*Jr. A. M. Ass.*, April 22) urges the importance of giving the eyes rest, which can be done in emmetropic eyes by looking off at a distance. The hypermetropic eye can not thus rest, however, because it must accommodate to see clearly at any distance. Muscles are not rested by removing part of the burden they bear, but by being allowed to relax completely. This the hypermetropic eye cannot do so long as the eyes are open. Hence, in many cases of eye strain, complete relief is gotten only by correcting all of the hypermetropia and having the patient wear the correction for distant as well as near vision, as not until this is done do the ciliary muscles get a chance to relax entirely.

Dixon holds that, contrary to general opinion, it is better in these cases to slightly over correct than to under correct the hypermetropia. The thing sought for should be, not clear distant vision, but ability to use the eyes with comfort.

## PRESBYOPIA.

E. J. Gardiner (*Jr. Am. Med. Ass.*, Dec. 17) contends that, owing to a prejudice based on either vanity or ignorance, the wearing of presbyopic glasses is deferred too long, at the expense of comfort, efficiency, and often the health of the eye. He thinks the prejudice should be overcome, and that properly adjusted glasses for close work should be worn as soon as the amount of accommodation is so reduced that it requires an effort to see distinctly without the aid of glasses.

## RELATION OF DISEASES OF THE EYE TO THOSE OF THE TEETH.

W. M. Carhart (*Med. Review of Reviews*, Feb. 25) notes that the same periosteum which lines the orbital cavity extends to the alveolar border of the upper jaw; the mucous membrane of the mouth is in direct continuation with the conjunctiva. Often the roots of the upper teeth extend directly into the antrum of Highmore, from whence disease frequently reaches the orbit through the thin partition of bone. The angular artery and certain veins run almost directly from one region to the other. The same general nervous supply reaches both, not only through the fifth pair, but also through the sympathetic system. Hence, it is not difficult to understand the closeness of the relation between diseases of the eye and teeth.

He quotes Wendell Reber (*Ophthalmology*, Vol I, No. 1) as offering the following conclusions:

1. The ophthalmologist should seek the assistance of the dental surgeon in all cases of unexplainable paralysis of the accommodation, dilatation of the pupil, palsy or spasm of the external ocular muscles, rebellious corneal ulcers, phlyctenular disease, lacrimal fistula, orbital cellulitis, abscess, caries and periostitis, and in threatening glaucoma without apparent cause.

2. The dental surgeon should refer to the ophthalmic surgeon patients that develop any ocular symptoms whatever, and in particular those exhibiting altered pupils or accommodation, lowered vision, painful eyeballs and swollen lids or orbital margins with prominence of the eyeball. The latter is particularly important, as pus in the orbit will almost invariably do some damage.

3. From two to ten days is the time wherein infection from an alveolar wound is most likely to take place.

4. The so-called reflex affections (traumatic hysteria) may occur at almost any time within six months after an extraction. Impressionable females are the likeliest subjects for the development of this puzzling phenomenon.

5. Eye-strain in certain diseases of the eye may give rise to neuralgias reflected along the dental branches of the fifth nerve, and thus make it appear as though the teeth were the primary offending cause.

6. The small and the first great molar most frequently provoke the process that later involves the antrum of Highmore, the lacrimal sac, and even the orbit.

7. As Garretson has well said: "A diseased tooth may express itself in almost any part of the body, while, on the other hand, disease in any part of the body may express itself in discomfort through a tooth."

#### THE TREATMENT OF TRACHOMA BY MEANS OF RADIUM.

J. V. Zelenkovski (*Roussky Vratch*, May 14) reports his experiments of treating four cases of trachoma with radium. They were pronounced cases, with typical granulations, which usually would be submitted to operation.

One milligramme of radium, sealed in a thin glass tube, was slowly moved over the mucous membrane of each lid, barely coming in contact with it, for a period of five or ten minutes. Eight to fourteen applications were made, and no other treatment was given. Of seven eyes treated by this method, five were permanently cured and the other two were rapidly improving. The granulations disappeared without leaving any scars or other evidence of their former presence.

The author believes that radium is very useful in the treatment of this disease, and that no danger attends its use if the amount of radium and the length of the exposure are properly regulated.

#### SUBCONJUNCTIVAL SALT INJECTIONS.

S. D. Risley (*Jour. Am. Med. Asso.*, Aug. 12), after reporting a number of cases taken at random from those in which he has used this treatment, discusses the mode of operation. He has found material improvement to follow



saline subconjunctival injections in cases of abscess of the cornea; interstitial keratitis; vascular keratitis, with iritis; high myopia, with atrophic choroiditis, macular hæmorrhage, and commencing separation of the retina; as well as in other groups of cases.

He discusses the different theories as to how injections do good, and concludes that probably by rapidly dilating the channels of exit and diluting their contents, the flow of lymph is assisted through the normal channels, and that once emptied of their contents these channels are quickly filled with lymph richer in albuminoids derived from normal sources, which would thus better nourish the tissues. It has been observed that the prolonged use of saline stupes, or of solutions of crystalline substances, if they come in contact with the conjunctival sac, also do good; and the question has arisen in Risley's mind whether, perhaps, the collyriæ, i. e. solutions of alum, borax, zinc salts, etc., that have been found of material service in many cases, may not act by osmotic diffusion, thus causing a dilution of the contents of the lymph channels.

#### OBSTRUCTION IN THE RETINAL ARTERIES.

Allen Greenwood (*Jour. Am. Med. Asso.*, March 11) says the three most frequent causes of obstruction in the retinal arteries are arterial disease, embolism, and spasm. Thrombosis in a healthy retinal artery is a very rare occurrence, while in the pathological conditions mentioned it is rarely absent. Arterio-sclerosis, occurring as part of a general degeneration of the arteries, is perhaps responsible for more cases of obstruction of the retinal arteries than any other cause, although its importance is not always recognized and the actual condition is frequently overlooked. The ophthalmoscope shows a slight increase in the reflex from the arteries, with irregularities in their size, and where an artery crosses a vein the latter is often compressed, dilating it at the distal end, and more of the vein is hidden than the apparent width of the artery, showing that the latter has thicker walls than usual. The discs are often slightly congested and a feathery outline is observed, with a feathery exudate beside the arteries. If the central artery in the nerve is thickened, it often imparts a pulsation to the veins

which can be seen with the ophthalmoscope. When these conditions are found, they should warn us of advancing arterial disease. As the disease progresses the picture changes and lesions in the retina appear, caused by small arterioles becoming so sclerosed that their lumen are occluded. The part of the retina supplied by these vessels not being properly nourished, a local œdema occurs, with subsequent degeneration; or the weakened, diseased vessel walls give way and we have retinal hæmorrhages. In this stage we may have the appearances of the early stages of degenerative albuminuric retinitis. Often the kidneys are involved, and at other times arterio-sclerosis effects the eyes with no apparent involvement of the kidneys.

Embolism of a retinal artery is usually associated with diseased heart valves or a heart thrombus, although it is possible for it to be caused by a globule of fat getting into the circulation, following fracture of the tibia or femur, or by a foreign substance introduced into the circulation, such as paraffin injections used in reducing nasal deformities, etc. In any of these cases there is sudden loss of sight with the fundus changes described by Graefe.

It is now fairly well proven that spasm of the retinal arteries may be marked enough to obstruct the flow of blood. This condition is most likely to occur where endarteritis exists. For this reason a permanent occlusion of the vessel may take place after repeated temporary obstructions by spasm, as occurred in Wagenman's classical and frequently observed case.

The treatment of retinal arterio-sclerosis consists largely in regulating the patient's habits, avoiding nerve strain and all excesses. Medicinally, iodide of potash should be given in small doses for a long time.

In embolism, nitroglycerine should be given internally and the eyeball massaged, if seen shortly after the outset of the trouble.

Where spasm occurs nitrite of amyl may be used to abort them, and the treatment outlined for arterio-sclerosis should be carried out to prevent, if possible, the permanent occlusion of the vessels.

## BOOK REVIEWS.

**MANUAL OF DISEASES OF THE EYE.** By CHAS. H. MAY. 4th Edition. With 400 pages and 21 colored plates. William Wood & Co., New York: 1905. Price \$2.00.

The rapidity with which a new edition of this handy and very commendable manual has become necessary, must surely be gratifying to the author. This, the 4th edition, is brought up to date, and it has numerous new illustrations to elucidate the subjects treated on.

**REFRACTION AND HOW TO REFRACT.** 3rd Edition, with 215 illustrations. By JAMES THORINGTON, A.M., M.D. P. Blakiston's Sons & Co., Philadelphia: 1904. Price \$1.50.

This new edition of Thorington's work has some valuable additions which render it more useful than its predecessors. It handles the whole subject of refraction clearly and exhaustively and teaches the student in a plain manner how to go about in order to measure the refraction of the eye successfully.

**MANUAL OF PRACTICAL OPHTHALMOLOGY.** By G. A. BERRY, M.B., F.R.C.S., Ed. With 223 illustrations. J. B. Lippincott Co., Philadelphia: 1905.

Berry's manual on ophthalmology adds one more to the list of excellent and practical text books which are at the disposal of the student. While not remaining silent on the opinions of others, the author lays especial stress on his personal experiences in the treatment of eye diseases. The illustrations, though in black and white only, are excellent. The name of the author is a recommendation in itself.

**L'OEIL ARTIFICIEL (The artificial eye).** By DR. ROBERT COULOMB. 27 photographic plates and 123 figures. J.B. Baillière et Fils, Paris: 1905.

A most interesting book. After having given the history of artificial eyes in ancient and modern times, including the modes of manufacture, the author devotes considerable space to the adaptation of the artificial eye, its best shape, to the methods of forming a good and serviceable stump and orbital cavity. The many excellent illustrations add greatly to the

book, which throws much light on a chapter in ophthalmology which is only too often neglected by the ophthalmic surgeon. A study of this scholarly treatise will amply repay the reader.

**ZUR KROENLEINSCHEN OPERATION (on Kroenlein's Operation)**

By DR. JOSEPH HELBRON. With 2 plates. Berlin, 1905: S. Karger. Price 3.50 mark.

In this paper, which comes from the Eye Clinic of Prof. Michel in Berlin, the author gives a detailed description of Kroenlein's operation for the removal of tumors and foreign substances from the orbit, and of all the modifications this operation has undergone in the hands of other surgeons. He describes its results in a large number of cases of his own and those published by others, 62 in all. In summing up he recommends Kroenlein's operation as indicated in order to attack all disease foci in the temporal half of the orbit, but more especially in order to remove cysts, cavernomata, tumors of the lacrimal gland, slow growing solid orbital tumors, tumors of the optic nerve, foreign bodies in the orbit, etc., and even for diagnostic purposes.

**BIOGRAPHIC CLINICS. Volume III. Essays concerning the influence of visual function, pathologic and physiologic, upon the health of patients. By GEORGE GOULD, M.D. P. Blakiston's Sons & Co., Philadelphia: 1905.**

This, perhaps the most interesting, third volume of Gould's biographic clinics, contains a number of papers by him, previously published, to which one by Simeon Snell and one by C. E. Pronger are added. They detail the influence of eye-strain on the general system, as do the former ones. Especial space is given to the influence of eye-strain on the production of scoliosis in school children. This chapter is particularly interesting and useful.

It seems a pity that what is true and undoubtedly good in the author's contentions, according to his statements, appears to be unappreciated by the majority of oculists and medical men. This is probably not the case. That we cannot all of us go the whole length with him, is undoubtedly true. Nevertheless, nobody can read the author's earnest appeals, which bear the evidence of his convictions, without benefit.

ALT.